Centralized Terminal Operation Control (CTOC) Concept

Capacity Increasing Concept TIM

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Overview

- Operating Domains
- Current Terminal Issues
- CTOC Concept
- CTOC Core Ideas
- CTOC Benefits/Metrics
- CTOC Challenges
- Summary

Operating Domains

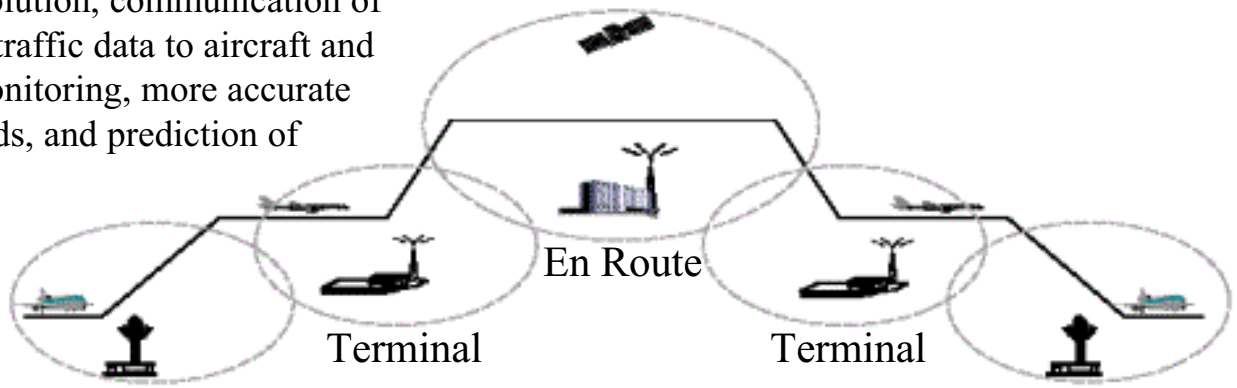
(Definitions from NASA NRA Solicitation, Appendix G)

En Route

Concepts dealing with planning and implementation of aircraft paths between takeoff and landing. This includes creating more flexible aircraft paths, conflict detection and resolution, communication of environment and traffic data to aircraft and ground, traffic monitoring, more accurate navigation methods, and prediction of traffic conditions.

System Level

Concepts dealing with all aspects of operations and management of the NAS.



Terminal

Concepts dealing with planning and implementation of departures and arrivals. This includes predicting and implementing runway allocations for takeoff and landing, dissemination of environmental data to ease planning, and methods to increase navigation accuracy for better flow management.

Surface

Concepts dealing with planning and implementation of airport surface traffic. This includes planning and monitoring of airport traffic, intra airport environmental data and aircraft state data as pertains to airport traffic.

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Current Terminal Issues (1 of 2)

- Underutilization of the Terminal airspace
  - Variability in threshold separations above legal minimum separations
  - Variability in pilots reaction to controller directives
  - Transfer of control introduces additional space and variability
- Additional spacing required for Instrument approaches
  - When conditions prohibit visual approaches (fog, low clouds, sunset, etc.) extra spacing is required for aircraft on final approach
- Inefficient communications between controllers and pilots
  - Communication errors cause extra spacing or in some cases, safety hazards
  - Problem exacerbated for pilots whose native language is not English
  - Variability in the delay between the issuance of a command and the response to the command

Current Terminal Issues (2 of 2)

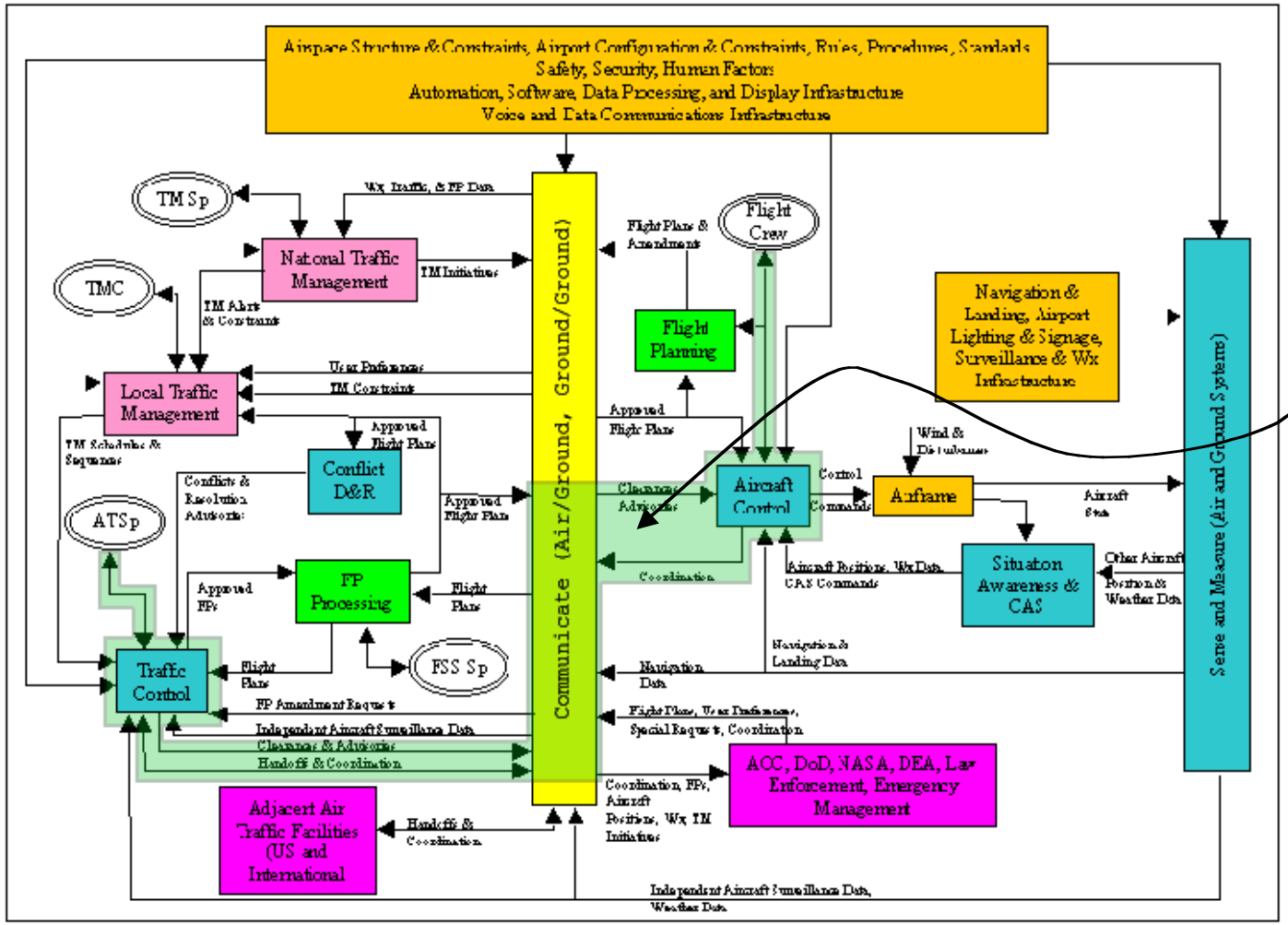
- Controllers are able to identify but not prevent unauthorized use of airspace
  - As witnessed recently, controllers are able to recognize when an aircraft is not responding to control directives, but they are unable to affect control of the aircraft
- Special procedures are necessary for varying aircraft performances
  - Aircraft may not be available or capable of mixing into a stream of other aircraft
  - Special handling of these aircraft impacts efficiency of controller and the operations of other aircraft in the area

CTOC Concept

- The Centralized Terminal Operation Control (CTOC) concept is analogous to the Maritime Industry's Harbor Pilot
- CTOC provides remote control of aircraft in the Terminal domain
- CTOC merges the role of the controller and flight crews
- CTOC will interface to DSTs and/or enhanced ATM systems in the Enroute, Terminal, and Surface environments to ensure predictable, consistent, conflict-free trajectories
- CTOC depends on aircraft technologies (i.e. datalink and FMS) for response to Flight Control Commands and Trajectories from the Remote Controller

CTOC Concept

Modified GFI Top-Level Model of ATM Functions



CTOC relevant components

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CTOC Core Ideas

- Remote control of one or multiple aircraft from a single terminal specialist supported by a ground-based computer system
- Remote control will extend existing automation in the terminal domain and reduce variability in separation
- Flight control commands based on deconflicted trajectories will be sent from CTOC to the aircraft FMS
- Remote control of terminal aircraft may be adjusted based on Air Traffic Management flow constraints
- Terminal specialists will have the capability to take control of aircraft to prevent unauthorized use
- Pilots will have the ability to override CTOC commands for safety reasons only

CTOC Benefits/Metrics

Benefit	Mechanism	Candidate Metric(s)
Increased Capacity	Control to predictable and consistent trajectories in Terminal area	Flow Rates, Arrival Delay, Departure Delay, Overall Delay, Time/Distance Flown
	Reduce runway occupancy	Runway Occupancy Time
	Arrivals and departures make better use of Terminal airspace	Flow Rates, Arrival Delay, Departure Delay, Overall Delay, Time/Distance Flown, Tracks
	Reduce variability in separation for aircraft-to-aircraft, aircraft-to-obstruction, and aircraft-to-airspace	Separation Distances, Conflicts
	Eliminate missed approaches due to verbal communication errors	Missed Approach Count
Increased Efficiency	Control to predictable and consistent trajectories in Terminal area	Tracks, Workload
	Improve situational awareness between Terminal ATC and airline users	Workload
	Eliminate missed approaches due to verbal communication errors	Missed Approach Count
	Collaborative arrival/departure management with airlines	Workload
	Reduce workload for Terminal area ATC and flight crews	Workload
	Provide communication between CTOC and FMS through data link	Comm Load, Workload
Increased Safety	Improve situational awareness between Terminal ATC and airline users	Safety Incident Count
	Provide communication between CTOC and FMS through data link	Comm Load
	Provide trajectory conformance monitoring	Separation Distances, Conflicts, Workload
	Provide flight deck override to CTOC	Safety Incident Count
	Provide ATC override for case of unauthorized use of Terminal airspace	Unauthorized Use of Airspace Count
Reduced Costs	Terminal area operating costs	Operating Costs, Staffing Levels

CTOC Challenges

- Acceptance
  - ATC, Flight Crews, and Public
- Human Factors
- Legal impact of change in roles and responsibilities
- Procedures for transfer of control
- Overrides
- Presence of Mixed Equipage

Summary

- CTOC is analogous to the role of a harbor pilot
- CTOC introduces multi-vehicle remote control by a single specialist in the Terminal domain
- CTOC increases Terminal domain capacity
- CTOC improves Terminal domain safety and efficiency
- CTOC reduces pilot-controller workload